REMARKS

Applicants have amended the claims of the above-identified application to further clarify the definition of the present invention. Specifically, claims 1, 13 and 14, the independent claims in the application, have been amended to recite that the compounding is performed at a temperature of 50°C or lower so as to inhibit reaction of the epoxy resin and the organophosphorous compound in the resin composition during the compounding. Note, for example, the paragraph bridging pages 4 and 5 of the specification of the above-identified application. In addition, dependencies of the previously considered claims have been amended, in light of the objection thereto in Item 2 on page 2 of the Office Action mailed May 7, 2003. In addition, in light of the change in dependency, Applicants are adding new claims 21-38 to the application. Claim 9 has been amended to add the word "claim".

In addition to new claims 21-38, Applicants are also adding new claims 19 and 20 to the application. Claims 19 and 20, each dependent on claim 1, respectively recites that in the resin composition, prior to use thereof in forming the prepreg, any reaction between the epoxy resin and the organophosphorous compound has been substantially completely avoided; and recites that in the resin composition, prior to use thereof in forming a prepreg, a ratio of amount of the organophosphorous compound that has reacted with the epoxy resin to an amount of unreacted organophosphorous compound is at most 0.5%. Note, for example, the sole full paragraph on page 10 of the Applicants' specification.

In view of the amendments in dependency to claims 4-7, 10, 12, 15 and 16, it is respectfully submitted that the objection to the claims under 37 CFR § 1.75(c), set forth

in Item 2 on page 2 of the Office Action mailed May 7, 2003, is moot.

Applicants respectfully submit that all of the claims presented for consideration by the Examiner patentably distinguish over the teachings of the references applied by the Examiner in rejecting claims in the Office Action mailed May 7, 2003, that is, the teachings of the U.S. Patents to Sagara, et al., No. 6,524,709, and to Wang, et al., No. 6,291,626, under the provisions of 35 USC §102 and 35 USC §103.

It is respectfully submitted that these references as applied by the Examiner would have neither disclosed nor would have suggested such a resin composition, or such method for producing a resin composition, or uses of such resin composition in a prepreg, laminate and printed-wiring board (that is, both the prepreg, laminate and printed-wiring board made, as well as methods for forming these products), including, inter alia, wherein the resin composition has the epoxy resin and the organophosphorous compound thereof compounded at a temperature of 50°C or lower so as to inhibit reaction of the epoxy resin and the organophosphorous compound in the resin composition during the compounding. See claims 1, 13 and 14, as well as claims 10-12, 16-18, and 35-37, for example.

In addition, it is respectfully submitted that these applied references would have neither disclosed nor would have suggested such resin composition as in the present claims, including, inter alia, wherein in the resin composition, prior to use thereof in forming a prepreg, any reaction between the epoxy resin and the organophosphorous compound has been substantially completely avoided (see claim 19); and/or wherein a ratio of amount of the organophosphorous compound that has reacted with the epoxy resin to an amount of unreacted organophosphorous compound is at most 0.5% (see

claim 20).

Moreover, it is respectfully submitted that the teachings of the applied references would have neither disclosed nor would have suggested such method as in the present claims, having the features as discussed previously, and, moreover, wherein the epoxy resin and amine-type curing agent are allowed to react in the organic solvent at a temperature of from 80 to 140°C, and then compounding the organophosphorous compound to the reaction product of the epoxy resin and the amine-type curing agent at the temperature discussed previously. See claim 14.

Furthermore, it is respectfully submitted that the teachings of these applied references would have neither disclosed nor would have suggested the other aspects of the present invention as in the remaining claims, having features as discussed previously, and also including (but not limited to) specific materials for the epoxy resin, amine-type curing agent and organophosphorous compound as in, e.g., claims 2, 4, 6, 28 and 29; and/or amounts of the above-referred-to components as in, e.g., claims 3, 5, 7, 33 and 34; and/or wherein the composition additionally includes at least one inorganic filler, a specified amount, as set forth in claims 7, 22-25 and 30.

The present invention is directed to a resin composition, methods of forming such composition, structures such as prepregs, laminates and printed-wiring boards formed using such resin composition, and methods for production of such structures. The present invention is particularly directed to the resin composition and uses thereof, wherein substances harmful to the environment, for example, during disposal (such as incineration) of the structures formed, can be avoided.

Recently, in order to avoid release of harmful substances to the environment (for

example, avoiding the dioxin problem during incineration), there have been attempts to provide resin compositions, used in structures as discussed previously, containing flame retardants, wherein such flame retardants contain no halogen compound. Such compositions include flame retardants such as the metal hydroxide type, phosphorous type and melamine-modified resin type; phosphorous-containing flame retardants are particularly useful because a great flame-retarding effect can be attained, even when the phosphorous-containing flame retardants are used in small amounts. Note the paragraph bridging pages 1 and 2 of Applicants' specification.

As one technique for incorporating phosphorous-containing flame retardants in resin compositions, there has been disclosed a resin composition containing a reaction product resulting from an epoxy resin and an organophosphorous compound. However, with respect to the reaction product which has been reported, both the epoxy resin and the organophosphorous compound are polyfunctional, and, therefore, crosslinking structures easily occur in the reaction product, so that it is very difficult to control reactivity. Moreover, there are problems in that the reaction product has a very large epoxy equivalent and has reduced curability. Note the paragraph bridging pages 2 and 3 of Applicants' specification.

Against this background, Applicants provide a resin composition, useful for prepregs and structures formed therefrom, as well as methods of forming and using the resin composition, which composition has good flame retardancy without containing any halogen-containing flame retardant, has good heat resistance and good chemical resistance, and also achieves good reaction stability or curability. Applicants have found that by using a resin composition containing an epoxy resin and an

organophosphorous compound having a specified structure, wherein the epoxy resin and organophosphorous compound have been compounded (e.g., mixed) at a temperature of 50°C or lower, such that reaction between the epoxy resin and the organophosphorous compound is substantially inhibited until the resin composition is used for preparation of prepregs, desired flame retardancy is achieved while avoiding reaction instability or curability caused by consumption of the epoxy resin through a reaction occurring during compounding of the resin composition. Applicants have found that in providing the compounding for forming the resin composition at a temperature of 50°C or lower, reaction between the epoxy resin and the organophosphorous compound can be substantially completely avoided, so as to avoid the above-referred-to instability which is a disadvantage in prior resin compositions, as described in Applicants' specification.

Moreover, Applicants provide a method wherein an epoxy resin compatible with the amine-type curing agent is achieved, in the absence of a solvent, while avoiding the above-mentioned instability. That is, Applicants have found that compatibility of the epoxy resin and amine-type curing agent can be achieved by reacting these components in the organic solvent at a temperature of 80-140°C, and thereafter, compounding the organophosphorous compound to the reaction product at the above-mentioned temperature of 50°C or lower. By performing the compounding after forming the reaction product of the epoxy resin and the amine-type curing agent, the amine-type curing agent and epoxy resin can be made compatible without forming a reaction product with the organophosphorous compound, with the attendant problems arising when the organophosphorous compound is reacted with the epoxy resin during

compounding of the resin composition, as discussed previously.

Sagara, et al. discloses a phosphorous-containing epoxy resin composition with flame retardancy. Disclosed are flame-retardant epoxy resins not containing any halogen. The phosphorous-containing epoxy resin compositions include an epoxy resin composition (a) in which a phosphorous containing epoxy resin (A) and a hardener are contained. See column 1, lines 12-16 and 51-56, and column 2, lines 37-40. This patent discloses that the phosphorous-containing epoxy resin (A) is a phosphorous-containing resin prepared by reacting phosphorous-containing organic compounds (B) obtained by the reaction in the range of molar ratio of 1.01 to 2 mols of organic phosphorous compounds (b) having one active hydrogen atom bonded to phosphorous atom with 1 mol of quinone compounds, with at least one kind of epoxy resin (C) selected from the group composed of general formulae (1) - (3) in column 3 of this patent. Note, column 2, lines 40-50. See also column 4, lines 41-44; the paragraph bridging columns 5 and 6; column 6, lines 16-18 and 35-43; and column 7, lines 42-56.

It is emphasized that Sagara, et al. discloses an epoxy resin composition wherein the epoxy resin has been reacted with a phosphorous-containing compound to provide a phosphorous-containing epoxy resin in the resin composition. It is respectfully submitted that such a phosphorous-containing epoxy resin in the resin composition, formed at the time of compounding, causes problems addressed by the present invention with respect to stability, which problems are avoided by the present invention wherein the organophosphorous compound remains substantially completely unreacted in the resin composition during the compounding. It is respectfully submitted

that Sagara, et al. would have neither taught nor would have suggested, and in fact would have taught away from, the resin composition, methods and structures according to the present invention, including wherein the epoxy resin and organophosphorous compound have been compounded at a temperature of 50°C or lower so as to inhibit reaction of the epoxy resin and the organophosphorous compound in the resin composition during the compounding.

The contention by the Examiner in the paragraph bridging pages 3 and 4 of the Office Action mailed May 7, 2003, that in Sagara, et al. the epoxy resin and the organophosphorous compound have been compounded at a temperature of 50°C or lower, is respectfully traversed. It is emphasized that Sagara, et al. discloses that during the compounding the phosphorous-containing compound reacts with the resin to produce a phosphorous-containing epoxy resin in the resin composition. Particularly in light of this disclosure, it is respectfully submitted that Sagara, et al. would have neither taught nor would have suggested, and in fact would have taught away from, the presently claimed resin composition and uses thereof including wherein the epoxy resin and organophosphorous compound have been compounded at a temperature of 50°C or lower so as to inhibit reaction of the epoxy resin and organophosphorous compound, as discussed previously.

The contention by the Examiner in the first full paragraph on page 4 of the Office Action mailed May 7, 2003, that the resulting product of the organic phosphorous compound and of the epoxy resin in Sagara, et al. "would have inherently satisfied the structure set forth in the present invention", is respectfully traversed. Again, it is emphasized that according to the present invention, in the resin composition the epoxy

resin and organophosphorous compound are separate components, which are substantially unreacted with each other. It is respectfully submitted that this is directly contrary to the resin composition of Sagara, et al., wherein the composition has a reaction product of the phosphorous compound and epoxy resin.

The further contention by the Examiner in the paragraph bridging pages 4 and 5 of the Office Action mailed May 7, 2003, that since Sagara, et al. does not disclose a temperature range for addition of the epoxy resin to the organophosphorous compound, when a temperature range is not disclosed it can be assumed that it takes place at room temperature, is respectfully traversed. It is respectfully submitted that Sagara, et al. clearly functionally sets forth a temperature of the compounding, in that this temperature is a temperature in which the phosphorous compound reacts with the epoxy resin. As is clear in Applicants' disclosure, various epoxy compounds, even without the presence of a reaction catalyst, will form a reaction product of the epoxy resin and phosphorous compound when the system is heated to 100°C or higher. See page 10, lines 5-23, of Applicants' specification. Especially in view of the purpose in Sagara, et al. of forming the phosphorous-containing epoxy resin in the resin composition, it is respectfully submitted that Sagara, et al. clearly would have neither disclosed nor would have suggested a temperature of, for example, room temperature, as alleged by the Examiner.

Additional contentions by the Examiner in connection with claims 1 and 2 being product-by-process claims, in the first paragraph on page 5 of the Office Action mailed May 7, 2003, are noted. Where the processing forms a different product, clearly the claim in product-by-process form must be considered with respect to the processing set

forth. See In re Luck, 177 USPQ 523, 525 (CCPA 1973). As is clear from the present disclosure and as discussed previously, the processing set forth in the present claims provides a different product (that is, a product with substantially no reaction between the organic phosphorous compound and epoxy resin) as compared with the product of Sagara, et al. In view thereof, it is respectfully submitted that the Examiner must take into account the processing as set forth in the present claims.

It is respectfully submitted that the additional teachings of Wang, et al. does not rectify deficiencies of Sagara, et al., such that the presently claimed invention as a whole would have been obvious to one of ordinary skill in the art. Wang discloses flame retardant advanced epoxy resins prepared from a bisphenol having phosphorous groups. The flame retardant epoxy resin and cured epoxy resin described in this patent are disclosed from column 2, line 64 to column 3, line 61. The Examiner has applied Wang, et al. as describing various phosphorous-containing compounds.

However, even assuming, arguendo, that Wang, et al. can be used to interpret organic phosphorous compounds in Sagara, et al., the teachings of Sagara, et al. and Wang, et al. would have neither taught nor would have suggested the presently claimed invention, including compounding at a temperature of 50°C or lower so as to inhibit reaction of the epoxy resin and the organophosphorous compound in the resin composition during the compounding, or other aspects of the present invention as discussed previously.

Contentions by the Examiner, in connection with, e.g., claim 14, that any variation between the prior art and the present invention represents a "change in sequence of adding ingredients", and that the selection of any order is prima facie

obvious, are respectfully traversed. As can be seen by the foregoing, by utilizing the sequence of processing steps as in the present claims, both a compatible epoxy resin/amine-type curing agent combination can be achieved, and while also avoiding reaction of the organophosphorous compound and epoxy resin. Particularly in view of these advantages, it is respectfully submitted that the Examiner has not established obviousness merely through an allegation that the selection of any order of mixing ingredients is prima facie obvious. Clearly, in view of the unexpectedly better results achieved by the order of mixing and reacting as in present claim 14, and advantages achieved thereby, Applicants have established that they have not merely selected an order of mixing ingredients.

In view of the foregoing comments and amendments, reconsideration and allowance of all claims remaining in the application are respectfully respected.

To the extent necessary, Applicants petition for an extension of time under 37 CFR § 1.136. Please charge any shortage in fees due in connection with the filing of

this paper, including extension of time fees, to the Deposit Account No. 01-2135 (Case No. 511.41182X00), and please credit any excess fees to such Deposit Account.

Respectfully submitted,

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